

# 5

# Categorizing Resource Costs

## General

1. This chapter involves identifying resources and the types of costs that can be attributed to the broad categories of personnel, equipment and facilities. Each cost analysis will involve a mix of personnel, equipment and facility resources. By using the following questions as a framework, an analyst can align their analysis based on the resource requirements:

- a. Who is affected by the alternative: both directly and indirectly?
- b. What specific equipment, if any, is required to accomplish the tasks of these individuals?
- c. What facilities are used to house these individuals and their equipment?

## General

### Key Terms Used

### Types of Costs

### Personnel Costs

### Equipment Costs

### Facility Costs

### Life Cycle Costs

### Cost Structure Development

**Key Terms used in this chapter:**

**Departmental Costs** – refers to costs directly attributable to the project for which the department pays.

**Direct Costs** - Costs that can be precisely attributed to producing or providing a good or service. These costs will increase or decrease in direct proportion to a change in level or activity. Such costs should be relatively straightforward to identify and measure.

**Fixed Costs** - Costs that remain unchanged, in total, for a given time period despite wide changes in the related total level of activity or volume.

**Full Cost** - The sum of all direct and indirect costs of the activity. Full costs include all personnel costs, all related fixed and variable operations and maintenance costs, and allocated costs, such as depreciation.

**Incremental Costs** - Additional costs incurred by an organization, above normal operating costs, resulting from added requirements. These costs will result in a requirement for additional resources or a reallocation of existing resources.

**Indicative Costs** – a developed estimate supported by standardized costs and research. The level of detail would encompass granularity of planned expenditures to all cost items greater than 10% of contract value supported by multiple quotes from vendors, identification of component parts, and plans for positions by rank. The actual price of the contract will be within +/- 25 % of an indicative number.

**Indirect Costs** - Costs that cannot be precisely attributed to producing or providing additional goods or services.

**Non-recurring Cost** - Costs incurred on a one-time basis. All non-recurring costs need not occur in a single year.

**Phasing** - The time sequence over which an activity will take place or the costs/expenditures will be incurred.

**Productive Time** - The time available for personnel to actively perform their duties. It is total paid time less holidays, training, leave requirements and administrative duties.

**Relevant Range** - The range of activity within which assumptions relative to the cost behaviour are valid.

**Rough Order Magnitude (ROM)** - a preliminary estimate based upon personal intuition. Generally, the actual price of a contract will be within +/- 40 % of the ROM number however, large variability can exist.

**Standard Costs** - National average costs, based on several years of historical data, of a particular resource, expressed per unit of activity such as full-time equivalent (FTE) for personnel and flying hours for aircraft.

**Step variable Costs** - Costs that change by discrete or step amounts with sufficient changes in the underlying related activity or volume.

**Substantive Costs** – a highly detailed cost breakdown of planned expenditures for all elements greater than 3% of contract price. The granularity would show evidence of a detailed plan for all expenditures identifying, for example, PY positions (rank and MOC specific), planned training courses, itemized list of spares and components, Historical equipment/infrastructure costs, actual usage, metres, etc. The actual price of the contract will prove to be within a band of values less than 15 % of the substantive number (+/- <15%) because of the research and supporting documents.

**Sunk Costs** - Costs that have already been incurred and therefore are unavoidable and cannot be changed by taking alternative actions. Sunk costs are usually not relevant to most decision-making processes.

**Variable Costs** - Costs that change, in total, in direct proportion to changes in the related activity or volume.

## Types of Costs

2. When analyzing a number of options, there may be some resource demands that remain the same regardless of the option chosen. In most cases these resources can be considered irrelevant to the decision from a costing perspective. Where this occurs, they can be excluded from the costing analysis in order to concentrate on the relevant **variable costs** that will have a true impact on the decision at hand. Variable costs are those that change in direct relation to changes in the relevant activity. An example of a variable cost would be the cost incurred for fuel consumed based on number of kilometres driven. For each additional kilometre driven, there will be a corresponding increase in the amount of fuel required. Costs that change in relation to larger changes in the related activity are termed **step variable costs**. An example of a step variable cost would be contracted repair and overhaul for the same trucks. Small changes in the number of kilometres driven will not initially affect the number of maintenance hours required, but large enough changes in this activity will eventually necessitate the addition of more maintenance people, and hence an increase in these costs.

3. If a change in activity does not change certain costs, these costs are known as **fixed costs**. If, however, a change in activity requires the use of additional resources, the costs related to these additional resources are known as **incremental costs**. Incremental costs can be fixed or variable in nature. For instance, if you are analyzing an option that requires the employment of a lawyer, this is an incremental cost for this option. You must pay the lawyer a retainer, which is a fixed cost, but each time the lawyer is required to provide a service you must pay a fee, which is a variable cost. When comparing alternatives, the incremental costs are of prime importance.

4. Costs will either have a direct or indirect relationship to a particular good or service. **Direct costs** can be precisely attributed to producing or providing a good or service, and will increase or decrease in direct proportion to a change in level or activity. An example of a direct cost of an aircraft flying hour activity would be petroleum. Petroleum costs increase directly with each increase in flying hours. **Indirect costs**, on the other hand, are those costs that cannot be specifically tied to the provision of a good or service and therefore will have to be allocated to the activity based on some type of allocation factor. An example of an indirect cost for an aircraft-flying hour would be Wing Support personnel cost. It is important to recognize that these definitions are relative to the activity or entity being costed. Costs classified as indirect to one activity may be direct costs to another. For instance, in order to prepare a costing of the Wing Comptroller service, personnel costs would become direct costs.

## Personnel Costs

6. The answer to the question "Who will be affected by the proposed alternatives?" is only the beginning of the personnel resource analysis. The next question is "How are the resources affected by the proposed alternative?"

- a. Is there a change in the quantity of personnel?
- b. Is there a change in the rank/classification of personnel?

- c. Is there a change in the mix of personnel (i.e., military/civilian conversion)?
- d. Is there a change in location or employment of personnel?
- e. Is there planning for the use of contractors or other forms of outsourcing?

7. Personnel costs are comprised of Military Personnel Costs (MPC) and Civilian Personnel Costs (CPC). The **standard costs** provided in the [Cost Factors Manual](#) (CFM) are categorized by rank and occupation for military personnel and classification and level for civilian personnel. A detailed breakdown of direct and indirect cost components for both military and civilian personnel is provided in the [Cost Factors Manual](#).

8. Departmental vs Full-Up Costs. Within the context of Project costs, the difference between Departmental and Full-up costs only applies to personnel in so far as Departmental costs only includes direct voted cost (Military – pay, Civilian – pay) plus 20% of total salary cost for Employee Benefits payments (EBP) (sometimes referred to as the Personnel Transfer Price). Full-up cost also includes indirect costs not directly attributable to the project or its specific funding requirement. This includes miscellaneous costs such as allowances, medical/dental costs, movement, clothing, etc. These indirect costs are approximated using the CFM Full Cost column. In the case of Capital Projects, the Capital Project Full Cost is used. The primary difference is that environmental allowances and several miscellaneous costs (Office stationery, postage, telephone, travel, etc) are not included as these should be costed separately by the Project and included in Departmental costs. GST is not applied to personnel costs. All other project costs are the same for Departmental and Full-up costs.

9. Many personnel costs are for services or equipment consumed by the population as a whole rather than by a specific individual (ie. Contracted Medical & Dental Services). It is important to determine if a change in the quantity or type of personnel resources will directly cause a change in the total cost. If the total cost is unlikely to change, these costs would be considered to be fixed and can be excluded from the cost analysis. If the change in personnel requirements is such that they change the nature of a cost behaviour, then the cost should be included in the analysis. The point in time or designated quantity where the nature of the costs change is called the "step" (up or down), and the distance between steps is called the cost's **relevant range**. The most common example of a resource's relevant range is the standards by which we establish personnel based on workload capability. For example, one mechanic can support a certain number of vehicles given a certain maintenance standard. Once the number of vehicles exceeds that certain number (the step), an additional mechanic will be required. While the standards that were maintained under CFP 219 are no longer relevant for costing purposes, some standards are available through the [Base Services Index \(BSI\)](#), which provides general guidelines on standards that organizations are expected to meet.

10. Change in Quantity. The most obvious change in resources is an increase or decrease in the number of personnel. Costs that will change in this scenario include the pay group of costs (basic pay, allowances and Government contributions and benefits) and possibly miscellaneous support costs (ie. travel, movement, clothing).
11. Change of Rank or Classification. A change in the rank or classification of personnel will generally affect the direct and indirect pay costs. There are also some allowances that are specific to certain civilian classifications that may warrant consideration. Similarly, some trades and classifications receive specialist pay that must be considered.
12. Change in Mix. A change in the mix of personnel between military components (Regular or Reserve) and between military and civilian personnel generally involves changes in the pay group of costs. The miscellaneous personnel support costs are also affected because DND support to Regular Force military personnel is more extensive than for civilian personnel.
13. Change of Location. A change in location of personnel can affect the allowances that are paid to personnel such as Accommodation Assistance Allowance, Isolation Allowance or Military Foreign Service Regulations (MFSR). A change in the employment of personnel can result in items such as Acting Pay, Field Operations Allowance and Temporary Duty costs. There are also some costs that are often incurred only once as a result of a change in personnel. These costs are called **non-recurring costs** and may include such items as recruiting, training, movement and relocation costs. These costs can be substantial and may offset potential savings because they are generally incurred in the short term while the cost savings may only be obtainable in the long term. For example, in the case of **Cost Moves** as the result of the creation of new positions, ADM (HR-Mil) requires that funding be provided based on the CFM cost move rate multiplied by a factor of 1.5 in order to address the domino effect on move requirements that result from the creation of each new position. These costs must be considered as if they were an investment to produce the return of cost savings. The **phasing** of these costs and returns is also an important factor in the analysis.
14. Cost Recoveries. When preparing a cost estimate for recovery purposes, the interests of the Crown and the nature of the recovery will dictate the resources to be costed. Personnel performing a task in support of a cost recoverable activity are often doing so in lieu of their normal duties. The time available to actively perform their regular duties is known as **productive time**. Productive time is determined as total paid time less holidays, training, leave requirements and administrative duties. Standards of productive time for military and civilian personnel have been established and are listed in the [Cost Factors Manual](#). For full cost recovery purposes, personnel costs are expressed as a percentage of productive time multiplied by the full cost rate for affected personnel.

## **Equipment Costs**

15. Equipment is defined for the purposes of this document as vehicles, weapon systems (ships, fighting vehicles, aircraft and personal weapons), radars and major information systems. The analysis of how the equipment identified will be affected is similar to that performed for personnel in that there are fixed, variable, and non-recurring cost components to equipment. For example, Petroleum, Oil & Lubricants (POL) is generally considered to be a variable cost associated with mobile equipment, whereas Spares, Repair & Overhaul (SR&O) costs are often a function of time, activity rate and type of usage.

16. Finding the cost of operating equipment is like solving an equation where the following questions are the variables whose values must be found:

- a. Is there a change in the quantity of equipment?
- b. Is there a change in the activity rate of the equipment?
- c. Is there a change in the type of equipment being used?
- d. Is there a change in the use of the equipment?
- e. Is there a change in the way the equipment will be maintained?

17. The answers to all these questions must be obtained or assumptions made because the equation cannot be solved with an unknown variable remaining. The analyst should attempt to answer the above questions to ascertain whether a particular equipment cost is relevant to the costing decision.

18. There may be other resources that are expended based on scales of entitlement or collateral support activities. They include such things as clothing, rations, and consumables, and the cost analysis must aim to identify all such resources.

## **Facility Costs**

19. Facilities are defined as the buildings, works and land required to accommodate personnel and their equipment in the performance of their assigned tasks. Facilities are generally grouped based on functionality and facility cost information is available on a national, provincial or local level. While the construction and use of buildings can influence the cost behaviour of facilities, costs are generally described as a function of area ( $m^2$ ), type of usage and location.

20. Facility standard costs include building maintenance, electricity, heating, water and sewage services, and janitorial services. As with personnel and equipment, there are fixed and variable costs associated with buildings. An unoccupied building has to be heated and maintained to a certain minimum standard to ensure its future usability. The addition of personnel or equipment into a building will generally (incrementally) raise the costs of electricity, heating and water and sewage costs. The analyst must have a good understanding of not only the quantities of facilities but also their operational and maintenance concepts.

### Life Cycle Costs

21. Life cycle costs have gained increasing importance within the approval process and in many cases must be assessed in order to develop a full appreciation of the differences between options under consideration. Life Cycle Costing (LCC), also called Whole Life Costing by some practitioners, is a technique to establish the total cost of ownership. It is a structured approach that addresses all the elements of this cost and can be used to produce a spending profile of the asset or service over its anticipated life-span<sup>1</sup>. The results of an LCC analysis can be used to assist management in the decision-making process where there is a choice of options. The accuracy of LCC analysis diminishes as it projects further into the future, so it is most valuable as a comparative tool when long term assumptions apply to all the options and consequently have the same impact. Projects that are likely to involve significant life cycle expenses once the asset is in service must attempt to provide an estimate of the total cost of ownership. Life cycle costs are an essential part of any submission that goes to the Minister, and potentially TBS for approval in the form of a decision document.

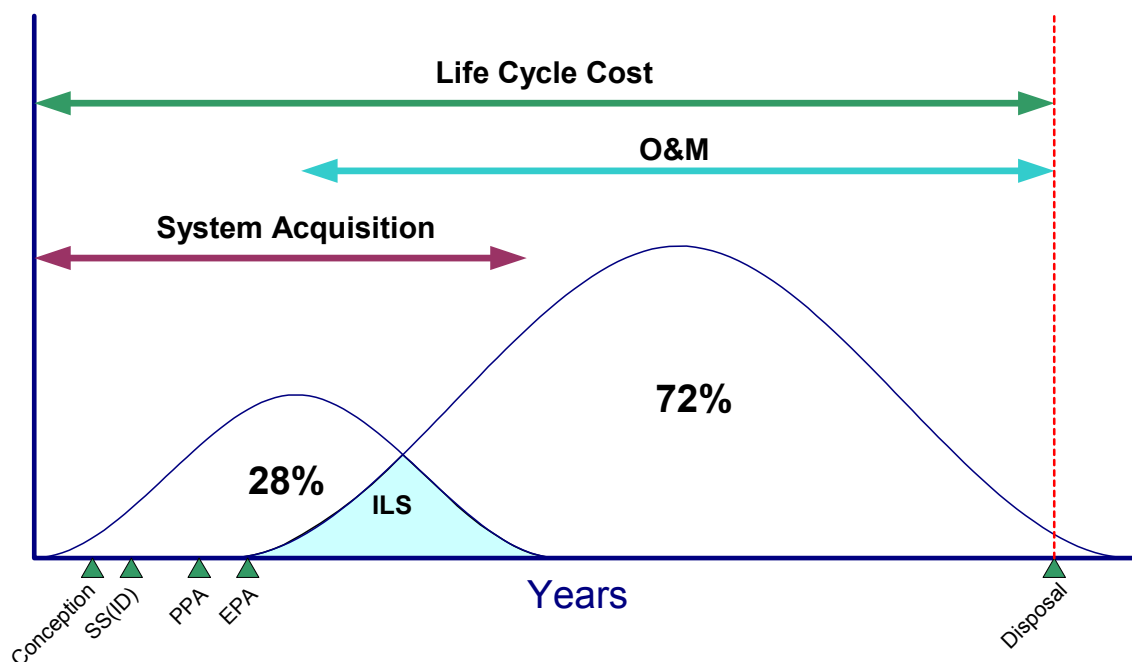
22. As a rule of thumb, total O&M related expenses represent 72% of an acquisition's total cost. As one can see from the diagram (Figure 5-1)<sup>2</sup>, once the acquisition process begins following an approved SS(EPA), O&M is expended immediately. However, some of these costs (in the shaded area) are comprised of initial logistic support (ILS) identified by the project, usually two to three years of operating costs and spares required to get the project going and to provide analysis on the budget impact. The 72% rule should be used as a basis prior to gathering specific data on operating, maintenance and engineering parameters.

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<sup>1</sup> United Kingdom. Office of Government Commerce, *Life Cycle Costing*  
<http://www.ogc.gov.uk/sdtoolkit/reference/deliverylifecycle/lifecyclecosting.html> accessed 4 May 2005

<sup>2</sup> BMB Consulting Services, Ottawa. Business Case Essentials presentation Winter of 2002/03

Figure 5-1 – Life Cycle Costs



23. In order to estimate the required annual recurring O&M, the total O&M estimate less the ILS identified within the project costing should be used. This will be in the range of 60%-66%<sup>3</sup> of the total life cycle cost. In terms of total acquisition cost this is approximately 1.5 to 2 times the total cost of acquisition including ILS. When one takes into account total O&M related costs, including ILS, this amount represents approximately 2.5 times the cost of acquisition. (All estimates are assumed to be actual costs incurred or \$BY of the acquisition, resulting in \$BY for the first year of operation. These amounts would need to be inflated for subsequent years)

$$\text{Annual Estimated O \& M} = \frac{1.5 \rightarrow 2 \times \text{Acquisition Cost}}{\text{Life Cycle (in Years)}}$$

24. For a project whose life is in the order of 20 years this would represent between 3 to 3.3% of the total life cycle cost or 4.5 to 6.6% of the acquisition cost on an annual basis. Therefore, a \$1B project (excluding ILS) would expect to consume between \$45M to \$66M in annual costs in the combined categories of Personnel, O&M and NP providing that the demand in operations is at an average rate. This is true for major capital projects with a stable lifecycle. Other types of projects (IT for example) would need to demonstrate different hypotheses as the life cycles are considerably shorter. Estimating the NPV of upgrades at regular intervals may normalize this situation.

<sup>3</sup> United States Department of Energy, Infrastructure Division. *Order 430.1 A, Life Cycle Asset Management, Chap 23* [www.sc.doe.gov/sc-80/sc-82/430-1/430-1-chp23.pdf](http://www.sc.doe.gov/sc-80/sc-82/430-1/430-1-chp23.pdf), accessed 4 May 2005



25. When betterments are applied, the following considerations come into play:
- a. Life Extension: O&M at the previous level is applied for duration of the extended lifecycle, ie. Old lifecycle is 20 years, new lifecycle extended to 30 years. Expected O&M to continue at the rate of \$45M to \$66M for the additional 10 year period.
  - b. Technological improvement: O&M at the previous level is applied, adding in the acquisition of the technological improvement and it's expected duration IAW the above formula, ie. A technological improvement of \$100M is added to our example project, it is expected to last 10 years, the expected total associated O&M cost of this improvement is \$150M to \$200M, therefore the projected annual cost is expected to be \$15M to \$20M, giving us a new annual O&M range of \$60M to \$86M annually.
26. These guidelines are not hard and fast rules, but should be used when no information on lifecycle costs are provided or when there exists a lack sufficient detail to be useful as a decision-making tool. Actual consumption and repair rates should be utilized whenever possible. In these cases, the guidelines can be used comparatively to establish a range of expected values. The guidelines can be used for benchmarking and continuous improvement of costing methodology.

## **Cost Structure Development**

### ***Work Breakdown Structure (WBS)***

27. One of the most important parts of a project planning process is the definition of activities that will be undertaken as part of the project. The list of activities is often called a Work Breakdown Structure (WBS), and it can be shown in one of two ways. It can be shown as an outline or it can be graphically presented. The activities outlined within the project WBS become a critical guideline to the costing analyst in ensuring that the project has considered all the major cost elements.
28. A work breakdown structure is a deliverable-oriented grouping of project elements that organizes and defines the total scope of the project: work not in the WBS is outside the scope of the project. As with the scope statement, the WBS is often used to develop or confirm a common understanding or project scope. Each descending level represents an increasingly detailed description of the project elements. The WBS is developed from the top down, starting with level 1 that comprises the complete project. The WBS is decomposed until the work is defined to a "manageable" level. "Manageable" depends upon several factors such as cost, risk, visibility and complexity. A WBS is normally presented in chart form; however, the WBS should not be confused with the method of presentation - drawing an unstructured activity list in chart form does not make it a WBS.

29. Each item in the WBS is generally assigned a unique identifier; these identifiers are often known collectively as the *code of accounts*. The items at the lowest level of the WBS are often referred to as *work packages*. These work packages may be further decomposed during activity definition. Work element descriptions are often collected in a *WBS dictionary*. A WBS dictionary will typically include work package descriptions as well as other planning information such as schedule dates, cost budgets, and staff assignments. As levels of the WBS become lower, the scope, complexity, and cost of each subtask becomes smaller. The lowest level tasks, or work packages, are independent, manageable units that are planned, budgeted, scheduled, and controlled on their own.

30. The initial WBS is a functional decomposition that accurately identifies all the functions performed by the project and depicts them in a tree-like fashion (graphically or as an indented list) to reflect the hierarchical relationship between these functions. The project is decomposed into sub-functions to the level necessary for the following purposes:

- a. identifying sub teams;
- b. identifying deliverables; and
- c. identifying WBS elements for estimating purposes.

31. Figure 5-2 provides a graphical example of a WBS. The example illustrates how the WBS breaks activities down in to progressively smaller components as it progresses down through the levels.

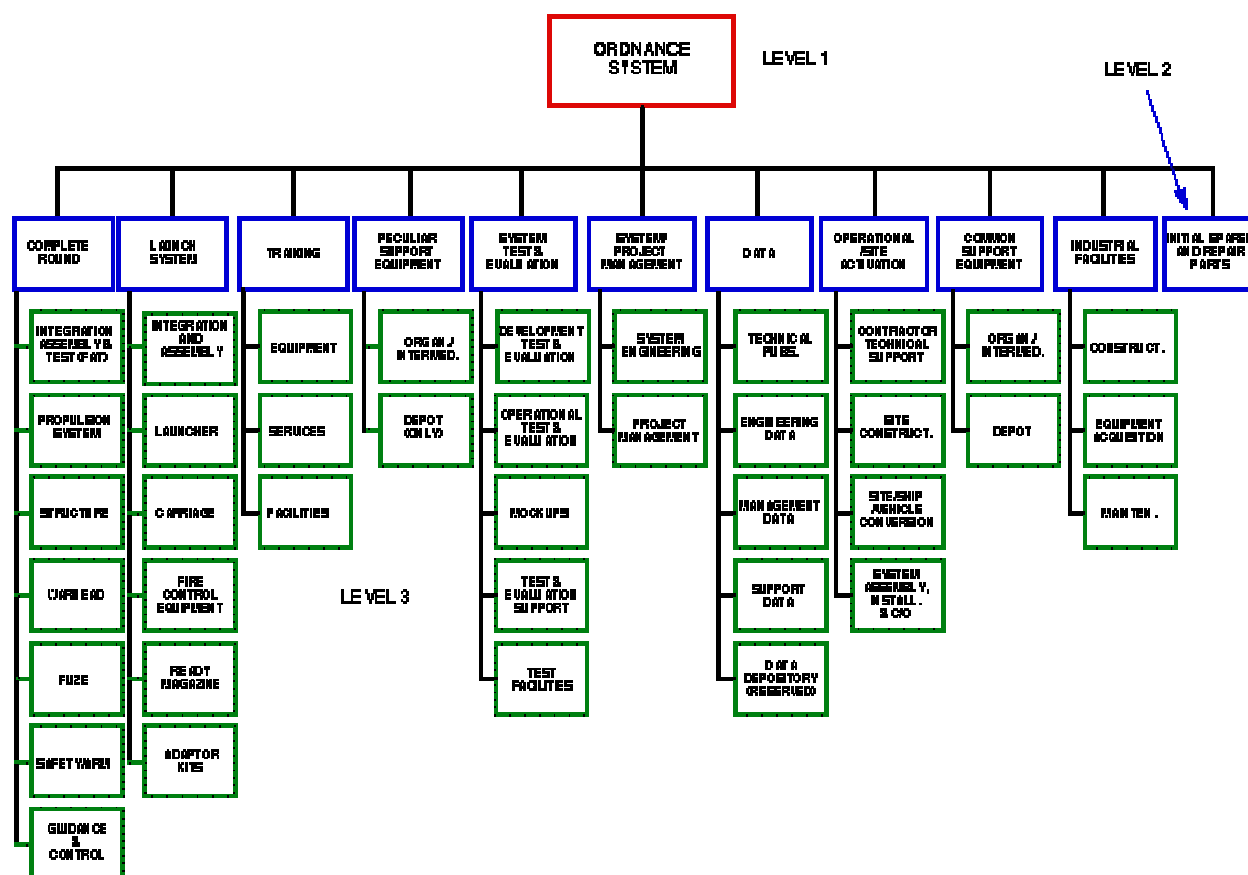


Figure 5-2 – WBS Graphical Structure

32. The example in Figure 5-3 provides a WBS using the outline structure. For the team member, this version provides the best communication for all concerned as the activity name fully describes both the action (Create, Review, Update) and the desired deliverable (Initial TSS Requirements Specification, Final TSS Design Specification). This allows the cost analyst to better understand detailed cost drivers within the planned activities.



Figure 5-3 – WBS Outline Structure

### ***Cost Element Structure***

33. From the WBS the Cost Element Structure (CES) can be developed. The structure will be unique to each costing exercise and will define the functions and resource categories associated with Project or Business Case being developed. A sample generic cost element structure follows. The CES for each costing analysis must be designed to meet the needs of the project team and meet the informational requirements for the review process such as the Project Approval Guide (PAG) in the case of capital projects. Through proper cost element development all critical assumptions will be considered and potential oversights can be minimized.

34. The detail in the CES is not required for formal project approval, however, it will be essential in developing the minimum level of detail for costing analysis. It is expected that most costing elements will be expanded during the analysis in order to develop detailed costs as part an Excel spreadsheet. This level of detail will be required by DSFC during the cost validation process that will be discussed in Chapter 11.

35. Below is an example of a generic CES for the procurement of military equipment. The example indicates the minimum level of detail required in order to develop a costing that will be relevant and comprehensive. In most cases, in the initial stages of the planning process many of the costs will be unknown, however, during preliminary meetings it is important to begin determining what cost elements will be essential and begin to gather the necessary information to develop estimates. Sources of information will be discussed in Chapter 6. To be able to track the progress of the project and effectively allocate funding once approved and received, it is advisable to develop cost elements that are consistent with the Financial Management Accounting System (FMAS) and the General Ledger (GL) accounts that will be used.

***Generic Cost Element Structure (Military Equipment Procurement)***

**1.0 RESEARCH, DEVELOPMENT, TEST, AND EVALUATION ELEMENTS**

- a. Development Engineering\*
- b. Producibility Engineering and Planning\*
- c. Development Tooling\*
- d. Prototype Manufacturing\*
- e. System Engineering/Program Management
- f. Project Management Administration (PM Civ/Mil)
- g. Other Project Management Costs
- h. System Test and Evaluation
- i. Training
- j. Data
- k. Support Equipment
- l. Peculiar
- m. Common
- n. Development Facilities
- o. Other Coosts

**2.0 PROCUREMENT-FUNDED ELEMENTS**

- a. Non-recurring Production
- b. Initial Production Facilities\*
- c. Production Base Support\*
- d. Other Non-recurring Production\*
- e. Recurring Production
- f. Manufacturing\*
- g. Recurring Engineering\*
- h. Sustaining Tooling\*
- i. Quality Control\*
- j. Other Recurring Production\*
- k. Engineering Changes\*
- l. System Engineering/Program Management

- m. Project Management Administration (PM Civ/Mil)
- n. Other Project Management Costs
- o. System Test and Evaluation, Production
- p. Training
- q. Data
- r. Support Equipment
- s. Peculiar
- t. Common
- u. Operational/Site Activation
- v. Fielding
- w. Initial Depot-Level Repairables (Spares)
- x. Initial Consumables (Repair Parts)
- y. Initial Support Equipment
- z. Transportation (Equipment To Unit)
- aa. New Equipment Training (Net)
- bb. Contractor Logistics Support
- cc. Training Ammunition/Missiles
- dd. War Reserve Ammunition/Missiles
- ee. Modifications
- ff. Other Procurement

\* These elements can be further subdivided to reflect the Level 3 major capital project WBS elements. Greater level of detail is permissible.

### **3.0 CONSTRUCTION FUNDED ELEMENTS**

- a. Development Construction
- b. Design and Engineering
- c. Contractor Construction Support
- d. Environmental Consultation
- e. Production Construction
- f. Operational/Site Activation Construction
- g. Other

### **4.0 PERSONNEL DIRECT-FUNDED ELEMENTS**

- a. Crew
- b. Maintenance
- c. System-Specific Support
- d. Civilian Permanent Staff
- e. Civilian Temporary Hires
- f. System Engineering/Program Management
- g. Project Management Administration
- h. Other Project Management Costs

- i. Replacement Personnel
- j. Training
- k. Permanent Change Of Station
- l. Other Costs

## **5.0 OPERATIONS AND MAINTENANCE (O&M)-FUNDED ELEMENTS**

- a. Field Maintenance Civilian Labour\*\*
- b. System-Specific Base Operations
- c. Replenishment Depot-Level Repairables (Spares)\*\*
- d. Replenishment Consumables (Repair Parts)\*\*
- e. Petroleum, Oil, and Lubricants (POL)\*\*
- f. End-Item Supply and Maintenance
- g. Overhaul
- h. Integrated Materiel Management
- i. Supply Depot Support
- j. Transportation
- k. Software
- l. System Test and Evaluation, Operational
- m. System Engineering/Program Management
- n. Project Management Administration (PM Civ)
- o. Other Project Management Costs
- p. Training
- q. Other O&M

\*\* These elements should be further subdivided to reflect the Level 2 prime major capital project WBS elements and the support equipment element. Greater level of detail is permissible.